Results for the 90% decrease scenario are:

Results for all scenarios except 90% decrease are:

	Annual Cost	Units	Unit Cost
End Office Switching	$29,413,351		
Port	$8,824,005	726,227 Lines	1.01 per line / month
Usage	20,589,346	9,552,246,145 min.	$0.0022 per min.

EO Switching Investment	Total
end office switching	$70,753,969

When real time BHCA are reduced by 90% the model yields only a marginal increase in switching costs.

Percent Change from default results for the 90% decrease scenario are:

	Annual Cost	Units	Unit Cost
End Office Switching	30.3%		
Port	30.3%	726,227 Lines	29.5% per line / month
Usage	30.3%	9,552,246,145 min.	29.4% per min.

EO Switching Investment	Total
end office switching	14.94%

The Hatfield model consistently understated switch costs in v2.2.2 and continues to understate them in R.3.0. Based on the model's response to these input changes one must arrive at the conclusion that it does not accurately measure switching costs.

HM R.3.0 employs a second capacity check based on BHCCS. HM V.2.2.2 also included BHCCS inputs but they are not discussed in the documentation for the wire center module.[7] The BHCCS default value increased from 1,000,000 in HM V.2.2.2 to 1,800,000 in HM R.3.0. If either of these tests (BHCA or BHCCS) results in a capacity limit an additional switch is added. The BHCCS input in HM V.2.2.2 was also an HAI assumption. The 80% increase in this input is suspect since the impact is a reduction in switching costs.[8]

[7] See, Model Description, Hatfield Model, Version 2.2, Release 2, pages 23 - 27, dated September 4, 1996.

[8] Additional Hardcoded assumptions and bulk limitations are included in the model. For example:

- The Dial Equipment Minutes to calculate the number of interoffice trunks required, all local trunk results are divided by 2. The assumption is apparently that both incoming and outgoing DEMS are measured for each end office. Trunks for carrier access do not receive this treatment and tandem trunks required by the DEMS calculation are multiplied by 2. The only rationale that currently presents itself is that both an incoming and an outgoing tandem trunk are required for tandem routing. This rationale does not, however, support the fact that Tandem routed Intralata trunks are treated the same as the carrier access trunks.

HM R.3.0 determines switch costs based on a switch cost curve defined by three data points. The model employs two switch cost curves, one for large and one for small companies. The large company curve is determined by a logarithmic curve using least-squares regression. They then state that "this functional form fit the data very closely" touting an R^2 of .9608. This curve is at best suspect. Based on the default line sizes in HM V.2.2.2 the per line switch costs from HM V.2.2.2 and HM R.3.0 (large companies) are:

Line Size	Costs V.2.2.2	Costs HM R.3.0
2,782	$220.00	$124.39
11,200	$86.00	$103.60
80,000	$59.00	$74.26

The small company curve was determined by multiplying the constant for the large company curve by a factor of 1.7, shifting it upward to reflect the relative differences in purchasing power. Whether a company experiences an increase or decrease in total switching costs from V.2.2.2 to R.3.0 depends on the where most of the Company's switches are on the curve with as well as the amount of port costs subtracted to arrive at the model's value for "installed EO switching per line." Determination of total switching costs in HM R.3.0 is problematic since it is allocated to several categories.

- Calculating the amount of investment required for a wire center with multiple switches, it is assumed that all switches will be supplied by the power equipment placed for the first switch.
- Land investment is also assumed not to vary with multiple switches.
- Interoffice electronics are assumed to be OC-48 backbone systems.
- Interoffice distance is assumed to be 1.5 times the square root of the wire center area.

Analysis shows that major changes have been made to the switch algorithms. In Hatfield 2.2 switch investment consisted of two components: End office switch investment and End office wire center investment. In Hatfield 3.0 the investment in land has been taken out of End office wire center investment and is shown separately but the input values used for calculating land investment remain the same. However a new component has been added in switch investment and is called Main Distribution Frame investment. It is not yet clear as to whether there is any equivalent lowering in some other portion of the switch investment module at the same time.[9]

In Hatfield 2.2 also the per line switch investment was given by a switch curve, the only difference being that it was a straight line. In that model also there was a differentiation between large and small switches but it was not based on the type of company (Hatfield 2.2 presumably contained analysis for only RBOCs) but was based on the wire center switch size with a cut off value of 11,200 lines. [10]

The input values used for deriving the switch curves in the two models are essentially the same for RBOC in V3.0 and Large in V2.2 in the 11,200 to 80,000 range and hence the two models will end up with the similar values for them if one adds the $16 which was taken out in Hatfield 2.2 (to account for trunk port investment which was presumably accounted for in the module's trunk calculation) as is shown in the table 1. (The documentation for V3.0 also mentions that this $16 has been taken out but this is probably done at a later stage)

Table 1

Line Size	V2.2	RBOC and SNET V3.0	NonRBOC V3.0
2,761	236.38	124.51	297.89
11,200	102.01	103.63	277.01
80,000	75.04	74.29	247.67

It is clear from the above table that for large companies (RBOCs) the per line switch cost is the same for higher switch sizes while they face a big lowering of value for small switch sizes. Since for RBOCs such small switches may be quite large the switch investment will come down as a result of this change. The per line switch investment for non RBOC companies in V3.0 is simply obtained by adding $173.38 to that for RBOCs for all line sizes.

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[9] In Hatfield 3.0 the per line switch investment is given by a switch curve:
Switch investment per line = 242.73 - 14.92*ln (no. of lines) (for RBOC and SNET)
Switch investment per line = 416.11 - 14.92*ln (no. of lines) (for others)

[10] The equations were
Switch investment per line = 90.40 - 0.000392*(no. of lines) (for lines > 11,200)
Switch investment per line = 264.28 - 0.0159*(no. of lines) (for lines < 11,200)

There is some modifications in the wire center investment also. In V2.2 wire center investment included investments for trunk port ($100 per line) for providing local trunk, OS trunk, direct routed access trunk, switched access trunk, intralata direct trunk and intralata tandem trunk. In V3.0 the only trunk port investment is for tandem routed access trunk. Whether the other costs have been allotted elsewhere is not clear. Moreover in V3.0 wire center investment is further reduced by $35 for each DLC line to account for analog line circuit offset for DLC lines. Hence the wire center investment is likely to be lower in V3.0.

There has been some improvement in calculation of power and building investment in V3.0 compared to V2.2 since in the previous version for all line sizes above 50,000, these investments were that for a 50,000 line switch. This has been corrected somewhat in V3.0 for all cases where more than one switch is needed (for lines > 80,000) although the formula is still somewhat inaccurate. However for switches between 50,000 and 80,000 lines V3.0 still includes the investment for 50,000 line. Moreover for switches of less than 50,000 lines, the calculation comes up with the lower end of the investment figures whenever the switch size is in between the line sizes given in table 2, rather than assigning the investment for the closest number. Thus if the line size is 49,999 then the investment value for 25,000 lines will be used instead of 50,000. The lowering of these investments occur because of the use of VLOOKUP function which picks up only the closest number which is lower than the actual number of lines while selecting the investment. One way of minimizing the problem may be to include more entries for in between line sizes in the above table so that the next lowest number is closer to the actual line size. In addition the power investment has been halved in V3.0 compared to what they were in V2.2 and no explanations are given for this reduction.

Served lines in wire center	Wire center investment w/o land ($)	Land investment ($)
0	42500	5000
1000	95000	15000
5000	220000	40000
25000	675000	150000
50000	1750000	400000

In the case of land investment the mistake in V2.2 has not been corrected and whatever be the line size, the land investment is the lower value closest to the value in table 2 and for line sizes above 50,000 lines the investment is that for a 50,000 line irrespective of the number of switches employed.

HM R.3.0 includes significant changes in the Tandem switching parameters. They are:

Parameter	HM V.2.2.2	HM R.3.0
real time limit, BHCA	1,500,000	750,000
port limit, trunks	120,000	100,000
max. trunk fill[11]	.8	.9
comm. equip. intercept factor	25	.50

The common equipment intercept factor in HM V.2.2.2 was used for the "scaling of tandem loop investment account for joint usage based on HAI experience."[12] The net impact of these changes is unclear.

Finally, extensive calculations and relationships occur in the interoffice trunk investment portion of the Switching and Interoffice spreadsheet. In sum, Dial Equipment Minutes are used to determine the type and amount of calling per line in an annual form and converted to Busy Hour CCS through annual to daily ratios and then through daily to busy hour ratios. These values are then divided by a trunk occupancy rate to determine the equivalent number of trunks required per line for that call type. All interoffice facilities are considered to be fiber cable and a mixture of aerial, buried and underground structures. Mixtures are created through the default table and can only be varied through scenario runs, instead of by office or by area. The default table split of aerial, buried and underground structure into 1/3 for telephone, 1/3 for power and 1/3 for cable TV still exists in HM3.0 and is also applied to the interoffice plant.

Distance inputs are contained in a separate worksheet and do not have formulas or references to indicate their source or makeup. Since the table is tri-columnar with wire center, STP distance and Tandem distance as its members, it is assumed that this is a manual input responsibility. It is unclear whether a set of default values has been created for the sample runs. As mentioned earlier, the basic interoffice distance calculation is based on 1.5 time the square root of the area associated with it. This area comes from the Loop Database inputs and is a summary of the areas of all CBGs associated with the wire center. Utilizing this calculation is analogous to assuming that a) all CBG areas configure themselves into a square around the wire center, b) that the distance to the edge of this square is the distance attributable to this wire center for interoffice purposes, c) that this wire center connects to an average of only three other wire centers and d) that those wire centers are contiguous to the one under study.

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[11] The nomenclature changed. In HM R.3.0 this is termed "maximum initial trunk port occupancy."

[12] Hatfield Model V. 2.2.2 - Input Summary, page 8 of 31.

It also appears that certain assumptions and calculations are being used to determine the what is termed "excess tandem switches" on a real time and trunk constrained basis. These algorithms are still under investigation and no documentation references have been found to explain them as yet.

Converting Investments into Annual Costs

There has been no improvement nor change to capital cost calculations in HM 3.0 (from HM 2.2.2). HM 3.0 still takes a simplistic approach to developing its capital costs. Its algorithms are based on a simple straight line depreciation method. The only "improvement" made to the capital costs methodology was the recognition of mid-year placement convention. At a minimum, the capital cost algorithms must incorporate industry standard, commission approved approaches such as:

- Survival Curves
- Net salvage (net of cost of removal and future salvage)
- Remaining lives
- Equal life group methodology
- Deferred taxes

The exclusion of these standard approaches in the algorithms severely underestimates the cost of capital and therefore severely underestimates the monthly costs of service (the underestimation may run as high as 10%).

In addition to the simplistic approach to the modeling, the input values used in the capital cost module are flawed. The debt and equity costs and the debt ratio are still based upon the 1984 MFJ (per Jim Vander Weide at the FCC Proxy model Workshops). Net salvage, gross receipts tax, property tax, insurance, and other state and local taxes seem to be ignored. And, deprecation lives are severely overstated (depreciation inputs will be covered in greater detail in the next section).

Depreciation lives have increased since HM 2.2.2. HM 3.0 bases its depreciation lives upon Prescribed results from Commission rulings, however these results do not reflect economic lives. Rather, they are a result of a political compromise. This compromise is based on the fact that commission staffs want low customer rates. Therefore, lives are typically longer than reality. This can be proven by the fact that state commissions and the FCC have repeatedly recognized depreciation reserve deficiencies. In addition, to the problems of their approach, Hatfield documentation does not state what years were used as the basis for the average.

The FCC has stated that economic lives of an efficient entrant should be used and that these estimates should realistically reflect the lives of plant. In addition, if the network is opened to competition the economic useful lives will suddenly decrease in recognition that customers will shift and that productive plant will suddenly become non-productive (i.e., new entrants will recognize that recently installed plant may become non-productive at any point in the future as they lose customers).

Finally, one estimate of actual lives that could be used are those currently espoused by the IXC's. In 1994, AT&T proposed at the FCC (the last time that AT&T had to go before the FCC to get lives approved) the following lives (compared to the depreciation lives proposed in HM 2.2.2 and 3.0):

		1994 AT&T Proposal	Hatfield 2.2.2 Proposal	Hatfield 3.0 Proposal
	Switch	9.7	14.3	16.54
Copper Cable:	Aerial	3.4	20	16.8
	Buried	15	20	19.86
	Under Ground	9	20	21.17
Fiber Cable:	Aerial	14.3	20	22.11
	Buried	16.8	20	24.13
	Under Ground	12.8	20	22.87

In addition to these plant specific lives, if one uses 1995 financial data from AT&T and MCI, their depreciation rates rage from 10-11%. These would yield a 9-10 year average plant life. These values are well below what Hatfield has proposed and even the values used in the BCPM, BCM2, and the CPM.

HM 3.0 offers no improvement over HM 2.2.2 in the calculation of expenses. HM 3.0 inputs still include underestimated values from a New Hampshire Marginal Cost Study, e.g. Billing /bill inquiry per line per month, alternative CO switching factor, and the alternative circuit equipment factor. In addition, HM 3.0 assumes that the level of investment is the major driver of expenses. This may be unrealistic assumption. For example, does the long loop, high investment customer incur more common costs, network operations, etc.. In fact, there are multiple drivers of operating expense. These should be investigated and used to derive the expenses.

Even if investment was determined to be the best driver of operating expenses, Hatfield's use of the ARMIS ratios is flawed. HM 3.0 still uses embedded plant to determine expense ratios, however, these are applied to Hatfield's forward looking investments. These forward looking expenses only represent 769/1609 of the embedded investment (based upon the 2.2.2 results as reported in paragraph 31 of the FCC staff analysis[13]). Therefore, the expenses in the Hatfield model reflect only 769/1609 of the current operating expenses. They then multiply these discounted expenses by an additional discount to account for "future efficiency

[13] "*The Use of Computer Models for Estimating Forward-Looking Economic Costs: A Staff Analysis,*" CCBPOL97-2, DA97-56 (rel. Jan. 9, 1997).

improvements". Specifically, HM 3.0 adjusts the Network Support expense factor by a forward looking adjustment of 50%, which is a decrease from 2.2.2's value of 70%, to account for improvements in efficiency. Therefore some accounts (network expenses) are below 25% of what is currently spent today on those items. These values are outlandish and also do not seem to take in to account the effect that competition will have on reducing economies-of-scale.

HM 3.0 still designates an inordinate amount of embedded costs. A comparison of the dollar amounts In our effort to validate the new release of the Hatfield Model, we have undertaken a similar validation analysis as done for HM 2.2.2. In particular, we have compared the dollar amounts of investment and expenses as predicted by the Hatfield Model, HM 3.0 to the corresponding actual ARMIS reported accounts. The results for CONTEL/ GTE of California, Inc. and GTE Texas are presented Appendix E.

The findings of this validation analysis indicate that the new release did not undergo any major structural improvements since it last release. As already shown in HM 2.2.2 and now in HM 3.0, the Hatfield Model designates inordinate portions of ILEC's investment and expense costs as being "embedded". For instance, for CONTEL/GTE of California, Inc, "General Support" which includes all 21XX ARMIS accounts, the Hatfield Model attributes approximately 85% of investment to "embedded" costs. In essence, this is saying that the Hatfield model claims to be able to serve all current GTE customers in California at the same quality level with only 15.3% of current investment in general support equipment such as land, motor vehicles, buildings, furniture, etc.

The use of the ARMIS ratios is flawed used to develop expense ratios in HM 3.0 are flawed. HM 3.0 uses embedded plant to determine expense ratios, however, these are applied to their forward looking investments. Their forward looking expenses only represent 769/1609 of the embedded investment (based upon the 2.2.2 results and the what the FCC staff stated in their analysis). Therefore, the expenses in the Hatfield model reflect only 769/1609 of the current operating expenses. HM 3.0 then adjust the Network Support expense factor by a forward looking adjustment of 50%, which is a decrease from 2.2.2's value of 70% to account for improvements in efficiency. These values are outlandishly overstated and do not seem to take in to account the effect that competition will have on reducing economies-of-scale. They then multiply these discounted expenses by the additional discount to account for "future efficiency improvements". Therefore some accounts (network expenses) are below 25% of what is currently spent today on that item.

Appendix A

Sensitivity Analysis: HM 2.2.2 versus HM 3.0

Summary Description of Analysis and Results

Sensitivity analysis was performed on Hatfield Model 2.2.2 (HM2.2.2) and Hatfield Model 3.0 (HM3.0) to compare the total loop unit cost per month for both of the models resulting from twenty different scenarios for the state of Washington.[14] Several of the models' inputs are modified including: fill factors, depreciation rates, cost of capital, distribution and feeder structure fraction assigned to telephone, and the variable/corporate overhead rate. The results are provided in the tables below. Two sets of analyses were performed distinguished by the value of the forward-looking network operations factor. HM2.2.2 employs a default value for this input of 70%, and HM3.0 uses 50% as the default value. The first set of results leaves the forward-looking network operations factor at the respective default values for each of the models. On the other hand, the second set of results provides a more accurate comparison, where the forward-looking network operations factor is set equal to 70% in both models.

The result tables below provide several interesting features. First, the monthly dollar amount of the total loop unit cost is provided for both of the models. In the far right column, the percent difference between these two amounts is provided. Below each monthly dollar figure is a percentage value in parentheses. This value is the percent difference between the monthly dollar figure for that particular scenario and the monthly dollar figure in the default scenario for that model. For example, in the first results table, scenario 11 shows a monthly dollar value of 15.76 for HM2.2.2 and a monthly dollar value of 17.09 for HM3.0. The percent difference between these two numbers is 8.44%. However, the monthly value of 15.76 is 25.58% greater than the default value for HM2.2.2 of 12.55. Likewise, the monthly value of 17.09 is 26.69% greater than the default value for HM3.0 of 13.49.

[14] The data used for this analysis is that supplied with the Hatfield Models for Pacific Northwest Bell in the state of Washington.

The results show that, HM2.2.2 is generally more sensitive to input changes than is HM3.0.

Following the tables of results is a section describing each of the scenarios. The exact input modifications made to each model for each of the scenarios is described in detail in the subsequent section.

Total Loop Unit Cost per Month – Results 1

Scenario	HM 2.2.2	HM 3.0	Percent Difference
Default	12.55 (0.00%)	13.49 (0.00%)	7.49%
1	13.51 (7.65%)	14.43 (6.97%)	6.81%
2	15.13 (20.56%)	15.92 (18.01%)	5.22%
3	12.83 (2.23%)	13.82 (2.45%)	7.72%
4	13.69 (9.08%)	14.85 (10.08%)	8.47%
5	15.33 (22.15%)	16.86 (24.98%)	9.98%
6	13.63 (8.61%)	14.73 (9.19%)	8.07%
7	14.76 (17.61%)	16.03 (18.83%)	8.60%
8	14.59 (16.25%)	14.87 (10.23%)	1.92%
9	13.70 (9.16%)	14.66 (8.67%)	7.01%
10	14.72 (17.29%)	15.87 (17.64%)	7.81%
11	15.76 (25.58%)	17.09 (26.69%)	8.44%
12	18.21 (45.10%)	18.78 (39.21%)	3.13%
13	19.86 (58.25%)	20.42 (51.37%)	2.82%
14	21.89 (74.42%)	22.30 (65.31%)	1.87%
15	21.93 (74.74%)	22.83 (69.24%)	4.10%
16	21.32 (69.88%)	22.01 (63.16%)	3.24%
17	24.14 (92.35%)	24.13 (78.87%)	-0.04%
18	23.49 (87.17%)	24.04 (78.21%)	2.34%
19	23.22 (85.02%)	24.30 (80.13%)	4.65%
20	25.56 (103.67%)	25.67 (90.29%)	0.43%

HM 2.2.2: Forward-Looking Network Operations Factor set equal to default value of 70%.
HM 3.0: Forward-Looking Network Operations Factor set equal to default value of 50%.

Total Loop Unit Cost per Month – Results 2

Scenario	HM 2.2.2	HM 3.0	Percent Difference
!!w10 Default	12.55 (0.00%)	14.10 (0.00%)	12.35%
1	13.51 (7.65%)	15.06 (6.81%)	11.47%
2	15.13 (20.56%)	16.56 (17.45%)	9.45%
3	12.83 (2.23%)	14.44 (2.41%)	12.55%
4	13.69 (9.08%)	15.47 (9.72%)	13.00%
5	15.33 (22.15%)	17.48 (23.97%)	14.02%
6	13.63 (8.61%)	15.35 (8.87%)	12.62%
7	14.76 (17.61%)	16.65 (18.09%)	12.80%
8	14.59 (16.25%)	15.50 (9.93%)	6.24%
9	13.70 (9.16%)	15.33 (8.72%)	11.90%
10	14.72 (17.29%)	16.50 (17.02%)	12.09%
11	15.76 (25.58%)	17.73 (25.74%)	12.50%
12	18.21 (45.10%)	19.43 (37.80%)	6.70%
13	19.86 (58.25%)	21.12 (49.79%)	6.34%
14	21.89 (74.42%)	23.02 (63.26%)	5.16%
15	21.93 (74.74%)	23.54 (66.95%)	7.34%
16	21.32 (69.88%)	22.71 (61.06%)	6.52%
17	24.14 (92.35%)	24.85 (76.24%)	2.94%
18	23.49 (87.17%)	24.76 (75.60%)	5.41%
19	23.22 (85.02%)	25.01 (77.38%)	7.71%
20	25.56 (103.67%)	26.38 (87.09%)	3.21%

Forward-Looking Network Operations Factor set equal to 70% in both models.

Sensitivity Analysis Scenarios

1. Fill Factors decreased 20%

2. Fill Factors decreased 40%

3. Economic Lives shortened 10%

4. Economic Lives shortened 30%

5. Economic Lives shortened 50%

6. Cost of Money increased from 10% to 12%

7. Cost of Money increased from 10% to 14%

8. Distribution and Feeder Structure Fraction Assigned to Telephone = 66%

9. Variable/Corporate Overhead Factor increased to 20%

10. Fill Factors decreased 20%

    Economic Lives shortened 30%

11. Fill Factors decreased 20%

    Economic Lives shortened 30%

    Cost of Money increased from 10% to 12%

12. Fill Factors decreased 20%

    Economic Lives shortened 30%

    Cost of Money increased from 10% to 12%

    Distribution and Feeder Structure Fraction Assigned to Telephone = 66%

13. Fill Factors decreased 20%

Economic Lives shortened 30%

Cost of Money increased from 10% to 12%

Distribution and Feeder Structure Fraction Assigned to Telephone = 66%

Variable/Corporate Overhead Factor increased to 20%

14. Fill Factors decreased 40%

    Economic Lives shortened 30%

    Cost of Money increased from 10% to 12%

    Distribution and Feeder Structure Fraction Assigned to Telephone = 66%

    Variable/Corporate Overhead Factor increased to 20%

15. Fill Factors decreased 20%

    Economic Lives shortened 50%

    Cost of Money increased from 10% to 12%

    Distribution and Feeder Structure Fraction Assigned to Telephone = 66%

    Variable/Corporate Overhead Factor increased to 20%

16. Fill Factors decreased 20%

    Economic Lives shortened 30%

    Cost of Money increased from 10% to 14%

    Distribution and Feeder Structure Fraction Assigned to Telephone = 66%

    Variable/Corporate Overhead Factor increased to 20%

17. Fill Factors decreased 40%

    Economic Lives shortened 50%

    Cost of Money increased from 10% to 12%

    Distribution and Feeder Structure Fraction Assigned to Telephone = 66%

    Variable/Corporate Overhead Factor increased to 20%

18. Fill Factors decreased 40%

Economic Lives shortened 30%

Cost of Money increased from 10% to 14%

Distribution and Feeder Structure Fraction Assigned to Telephone = 66%

Variable/Corporate Overhead Factor increased to 20%

19. Fill Factors decreased 20%

Economic Lives shortened 50%

Cost of Money increased from 10% to 14%

Distribution and Feeder Structure Fraction Assigned to Telephone = 66%

Variable/Corporate Overhead Factor increased to 20%

20. Fill Factors decreased 40%

Economic Lives shortened 50%

Cost of Money increased from 10% to 14%

Distribution and Feeder Structure Fraction Assigned to Telephone = 66%

Variable/Corporate Overhead Factor increased to 20%

Hatfield Model 2.2.2 – Input Modifications

Fill Factors Decreased 20%

	Feeder		Distribution	
Density	Default	New	Default	New
<5	.65	.52	.5	.4
5-200	.75	.6	.55	.44
200-650	.8	.64	.6	.48
650-850	.8	.64	.65	.52

850-2550	.8	.64	.7	.56
2550+	.8	.64	.75	.6

Fill Factors Decreased 40%

	Feeder		Distribution	
Density	Default	New	Default	New
<5	.65	.39	.5	.3
5-200	.75	.45	.55	.33
200-650	.8	.48	.6	.36
650-850	.8	.48	.65	.39
850-2550	.8	.48	.7	.42
2550+	.8	.48	.75	.45

Description	Default	Decreased 10%	Decreased 30%	Decreased 50%
Loop Distribution	20	18	14	10
Loop Feeder	20	18	14	10
Loop Concentrator	10	9	7	5
Wire Center	37	33.3	25.9	18.5
End Office Switching	14.3	12.87	10.01	7.15
Tandem Switching	14.3	12.87	10.01	7.15
Transport Facilities	19	17.1	13.3	9.5
Operator Systems	8	7.2	5.6	4
STP	14	12.6	9.8	7
SCP	14	12.6	9.8	7
SS7 Links	19	17.1	13.3	9.5
Public Telephones	9	8.1	6.3	4.5

General Support	7	6.3	4.9	3.5

Cost of Capital

	Default	Increased to 12%	Increased to 14%
Cost of Debt	.077	.097	.117
Cost of Equity	.119	.139	.159

Structure Fraction Assigned to Telephone = 66%

	Default	New
Distribution -- Aerial	.33	.66
Distribution -- Buried	.33	.66
Distribution -- Underground	.33	.66
Feeder -- Aerial	.33	.66
Feeder -- Buried	.33	.66
Feeder -- Underground	.33	.66

Variable Overhead Factor Increased to 20%

	Default	New
Variable Overhead Factor	0.1	0.2

Distribution Fill Factors

Density	Default	Decreased 20%	Decreased 40%
0-5	0.50	0.40	0.30
5-100	0.55	0.44	0.33
100-200	0.55	0.44	0.33

200-650	0.60	0.48	0.36
650-850	0.65	0.52	0.39
850-2,550	0.70	0.56	0.42
2,550-5,000	0.75	0.60	0.45
5,000-10,000	0.75	0.60	0.45
10,000+	0.75	0.60	0.45

Copper Feeder Fill Factors

Density	Default	Decreased 20%	Decreased 40%
0-5	0.65	0.52	0.39
5-100	0.75	0.60	0.45
100-200	0.80	0.64	0.48
200-650	0.80	0.64	0.48
650-850	0.80	0.64	0.48
850-2,550	0.80	0.64	0.48
2,550-5,000	0.80	0.64	0.48
5,000-10,000	0.80	0.64	0.48
10000+	0.80	0.64	0.48

Fiber Feeder Fill Factors

Density	Default	Decreased 20%	Decreased 40%
0-5	1	0.8	0.6
5-100	1	0.8	0.6
100-200	1	0.8	0.6
200-650	1	0.8	0.6
650-850	1	0.8	0.6
850-2,550	1	0.8	0.6

2,550-5,000	1	0.8	0.6
5,000-10,000	1	0.8	0.6
10,000+	1	0.8	0.6

Depreciation – Economic Lives

Account	Description	Default	Decreased 10%	Decreased 30%	Decreased 50%
2112	Motor Vehicles	9.16	8.24	6.41	4.58
2115	Garage Work Equipment	11.47	10.32	8.03	5.74
2116	Other Work Equipment	13.22	11.90	9.25	6.61
2121	Buildings	48.99	44.09	34.29	24.50
2122	Furniture	16.56	14.90	11.59	8.28
2123.1	Office Support Equipment	11.25	10.13	7.88	5.63
2123.2	Company Comm. Equipment	7.59	6.83	5.31	3.80
2124	General Purpose Computer	6.24	5.62	4.37	3.12
2212	Digital Electronic Switching	16.54	14.89	11.58	8.27
2220	Operator Systems	9.94	8.95	6.96	4.97
2232.2	Digital Circuit Equipment	10.09	9.08	7.06	5.05
2351	Public Telephone Term. Equipment	8.01	7.21	5.61	4.01
2362	NID/SAI	12.00	10.80	8.40	6.00
2411	Poles	16.13	14.52	11.29	8.07
2421.1	Aerial Cable - metallic	16.80	15.12	11.76	8.40
2421.2	Aerial Cable - non metallic	22.11	19.90	15.48	11.06
2422.1	Underground Cable - metallic	21.17	19.05	14.82	10.59
2422.2	Underground Cable - non metallic	22.87	20.58	16.01	11.44
2423.1	Buried Cable - metallic	19.86	17.87	13.90	9.93
2423.2	Buried Cable - non metallic	24.13	21.72	16.89	12.07

2426.1	Intrabuilding Cable - metallic	15.64	14.08	10.95	7.82
2426.2	Intrabuilding Cable - non metallic	23.65	21.29	16.56	11.83
2442	Conduit Systems	51.35	46.22	35.95	25.68

Cost of Capital

	Default	Increased to 12%	Increased to 14%
Cost of Debt	.077	.097	.117
Cost of Equity	.119	.139	.159

Distribution Structure Fraction Assigned to Telephone = 66%

	Aerial		Buried		Underground	
Density	Default	New	Default	New	Default	New
0-5	0.50	0.66	0.33	0.66	1.00	0.66
5-100	0.33	0.66	0.33	0.66	0.50	0.66
100-200	0.25	0.66	0.33	0.66	0.50	0.66
200-650	0.25	0.66	0.33	0.66	0.50	0.66
650-850	0.25	0.66	0.33	0.66	0.40	0.66
850-2,550	0.25	0.66	0.33	0.66	0.33	0.66
2,550-5,000	0.25	0.66	0.33	0.66	0.33	0.66
5,000-10,000	0.25	0.66	0.33	0.66	0.33	0.66
10,000+	0.25	0.66	0.33	0.66	0.33	0.66

Feeder Structure Fraction Assigned to Telephone = 66%

	Aerial		Buried		Underground	
Density	Default	New	Default	New	Default	New
0-5	0.50	0.66	0.40	0.66	0.50	0.66
5-100	0.33	0.66	0.40	0.66	0.50	0.66

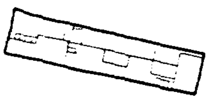
100-200	0.25	0.66	0.40	0.66	0.40	0.66
200-650	0.25	0.66	0.40	0.66	0.33	0.66
650-850	0.25	0.66	0.40	0.66	0.33	0.66
850-2,550	0.25	0.66	0.40	0.66	0.33	0.66
2,550-5,000	0.25	0.66	0.40	0.66	0.33	0.66
5,000-10,000	0.25	0.66	0.40	0.66	0.33	0.66
10,000+	0.25	0.66	0.40	0.66	0.33	0.66

Corporate Overhead Factor Increased to 20%

	Default	New
Corporate Overhead Factor	0.104	0.2

APPENDIX B

Comparison of Hatfield Model Release 3 and 2.2.2 Distribution Distances with Sums of Street Segment Lengths in Sample California CBGs



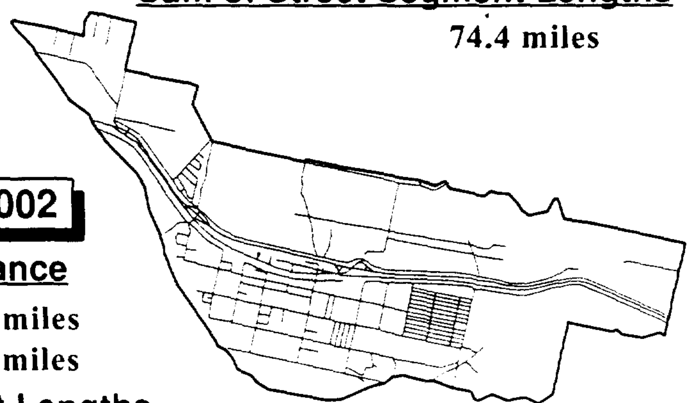
CBG 60650443.002

Distribution Distance

Release 3: 12.5 miles
Release 2.2.2: 0.8 miles

Sum of Street Segment Lengths

7.6 miles



CBG 60650438.063

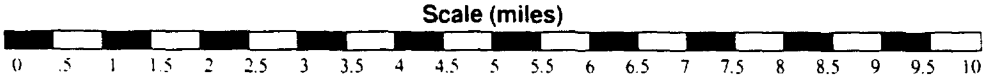
Distribution Distance

Release 3: 25.2 miles
Release 2.2.2: 3.0 miles

Sum of Street Segment Lengths

74.4 miles

Scale (miles)



Appendix C

Analysis of Hatfield CBG data

State	Hatfield Household Counts	Hatfield Average CBG distance	BCPM/ 1995Census Household Counts	BCPM Average CBG Distances	%Difference from Hatfield to 1995 Census Households	Actual Second Line Penetration	%Difference From Hatfield to BCPM CBG Distances
CA	15,495,577	8,897	11,033,168	9,302	40.4%	17.1%	-4.4%
CO	1,838,438	11,819	1,457,461	12,423	26.1%	14.7%	-4.9%
NJ	2,880,608	8,505	2,872,354	8,597	0.3%	32.1%	-1.1%
OH	5,056,088	9,475	4,198,488	9,683	20.4%	7.1%	-2.2%
TX	6,658,049	12,049	6,684,245	12,357	-0.4%	8.8%	-2.5%
WA	2,278,001	11,439	2,089,800	12,027	9.0%	9.7%	-4.9%

Note:

- *CBG distances are based upon weighted average of distance from CO to Centroid of CBG. The weighting factor used was Households*
- *The Second Line penetration was based upon 1995 Armis reported Residential lines divided by the 1995 Census Household counts.*